

A New Genus and Two New Species of Land Snails from the Lau Archipelago of Fiji

BY

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(3 Plates; 6 Text figures)

INTRODUCTION

SEVERAL COLLECTIONS OF LAND MOLLUSKS were made on some islands of the Lau Archipelago of Fiji by Harry S. Ladd in the early 1930's and by members of the Henry G. Lapham Expedition from the Bernice P. Bishop Museum in 1938. Despite this, many islands never have been sampled for mollusks. On others, only fragmentary collections were made during a few hours. Despite the limited material available, it is obvious that Lau is a major center of Pacific Island land snail diversity.

In late 1970, Mr. Laurie Price of Kaitia, New Zealand, collected on several islands for Field Museum of Natural History. Among the many mollusks obtained are the two very remarkable species of endodontid land snails described below. *Priceconcha tuvuthaensis* is a new genus and species from Tuvutha or Tuvuca Island, located approximately at 178°48'W and 17°40'S, and *Thaumatomodon spirrhymatum* is an extraordinary new species from Thithia or Cicia Island, located approximately at 179°20'W and 17°45'S.

A monograph of the Pacific Island Endodontidae (SOLEM, in press) was completed prior to receipt of this material. Rather than undertake extensive renumbering of charts, tables, and illustrations, it was decided to publish on these separately and insert only cross-references into the major work. Data concerning the criteria used to weigh characters and the bases for classification decisions are included in the main report and are not repeated here.

ACKNOWLEDGMENTS

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Carole W. Christman. Scanning Electron Microscope photographs were made during the course of cooperative research work with the American Dental Association Research Institute. I am deeply indebted to George Najarian and John Lenke of their Electron Optics Laboratory for assistance, to Fred Huysmans of Field Museum of Natural History for preparing the photographic prints, and to Mrs. Dorothy Karall for mounting and lettering the several figures.

SYSTEMATIC REVIEW

GASTROPODA

SIGMURETHRA

ENDODONTIDAE

Priceconcha Solem, gen. nov.

Endodontidae in which the major radial sculpture has been lost, microsculpture absent on spire and reduced to barely visible remnants on the last whorls. Shell larger than average, with greatly increased whorl count, averaging more than 7½ whorls in adults. Spire and apex strongly and almost evenly elevated, slightly rounded above, last whorl not descending, H/D ratio averaging about 0.555. Umbilicus broadly "V"-shaped, regularly decoiling, last whorl not decoiling more rapidly, contained about 2.90 times in the diameter, margins sharply rounded. A strong, thread-like keel and prominent supraparipheral sulcus present. Parietal wall with 5 barriers and 10 or 11 accessory traces extending more than a full whorl posteriorly. Columellar lamellae 2, with 2 accessory traces. Palatal wall with 4 subperipheral and

1 suprapерipheral barriers, plus 4 or 5 accessory lamellar traces. All major barriers with fine beading above. Radula typical endodontid, with tricuspid central, bicuspid laterals, marginals tricuspid with split ectocones. Genitalia greatly elongated, particularly in free oviduct and vas deferens area, basic structures as in *Thaumatodon*.

Type species: *Priceconcha tuvuthaensis* Solem, spec. nov.

Generic separation is based on the extreme conchological modifications seen in *Priceconcha tuvuthaensis* compared with the average endodontid pattern and the range of variation present in *Thaumatodon*. The great increase in whorl count, to more than $7\frac{3}{4}$ compared with a median $5\frac{1}{4}$ for the Endodontidae and mean $5\frac{1}{4}$ in *Thaumatodon*, striking reduction in shell sculpture, altered shape and coiling pattern, plus the extreme elongation of the apertural barriers are major changes. Conchologically, the most similar appearing genus is the Society Island *Nesodiscus*, particularly such species as *N. fabrefactus* (Pease, 1864) and *N. fictus* (Pease, 1864). These show the same pattern of increased whorl count and reduced sculpture, but are much larger in size, have greatly reduced apertural barriers, and lack the development of an epiphallus and shift in spermathecal insertion seen in *Priceconcha*. The differences between *Thaumatodon* and *Priceconcha* are of the same order of magnitude as the differences between *Nesodiscus* and its currently unnamed progenitor, the conchological equivalent of *Thaumatodon*.

In general appearance, the shell of *Priceconcha* seems to be a small, colorless trochomorphid. Only the remnant sculpture, visible at 96X or above, and the presence of beaded apertural barriers, show that it is an endodontid.

Great pleasure is taken in dedicating this genus to Mr. Laurie Price from Kaitaia, New Zealand. A Field Associate at Field Museum of Natural History and long-time collaborator in my work on Pacific Basin land mollusks, Mr. Price has contributed greatly to malacology.

Priceconcha tuvuthaensis Solem, spec. nov.

(Figures 2 to 9 and Figures 16, 17a, 19, and 20)

Diagnosis: Shell larger than average, diameter 4.05–4.54 mm (mean 4.29 mm), with $7\frac{1}{4}$ to $7\frac{3}{4}$ very tightly coiled whorls that increase only slightly in width. Apex and spire strongly elevated, slightly rounded above, body whorl not descending more rapidly, H/D ratio 0.528–0.587 (mean 0.558). Umbilicus broadly "V"-shaped, regularly and evenly decoiling, contained 2.73–3.07 times (mean 2.90) in the diameter, margin strongly rounded at base, sides

somewhat flattened internally. Apical whorls and early spire macroscopically and microscopically smooth, with vague radial growth striae visible by fifth whorl, surface on last two whorls with remnants of typical microreticulations (visible at 96X) between stronger radial growth striae. Peripheral keel edge showing crowded remnants of major rib swellings, interstices equal to their width, but swellings too vaguely outlined for counting. Sutures impressed on early spire, becoming progressively shal-

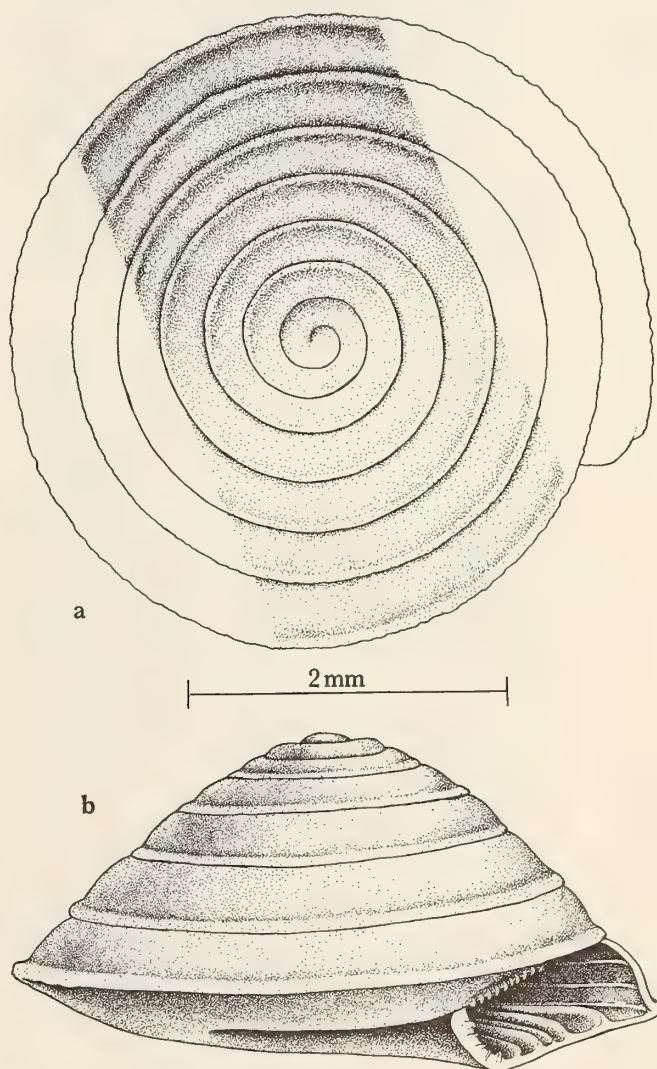


Figure 16

Priceconcha tuvuthaensis Solem, new species.

Holotype. FMNH 168131: a, top view of shell; b, side view.

Scale line equals 2 mm

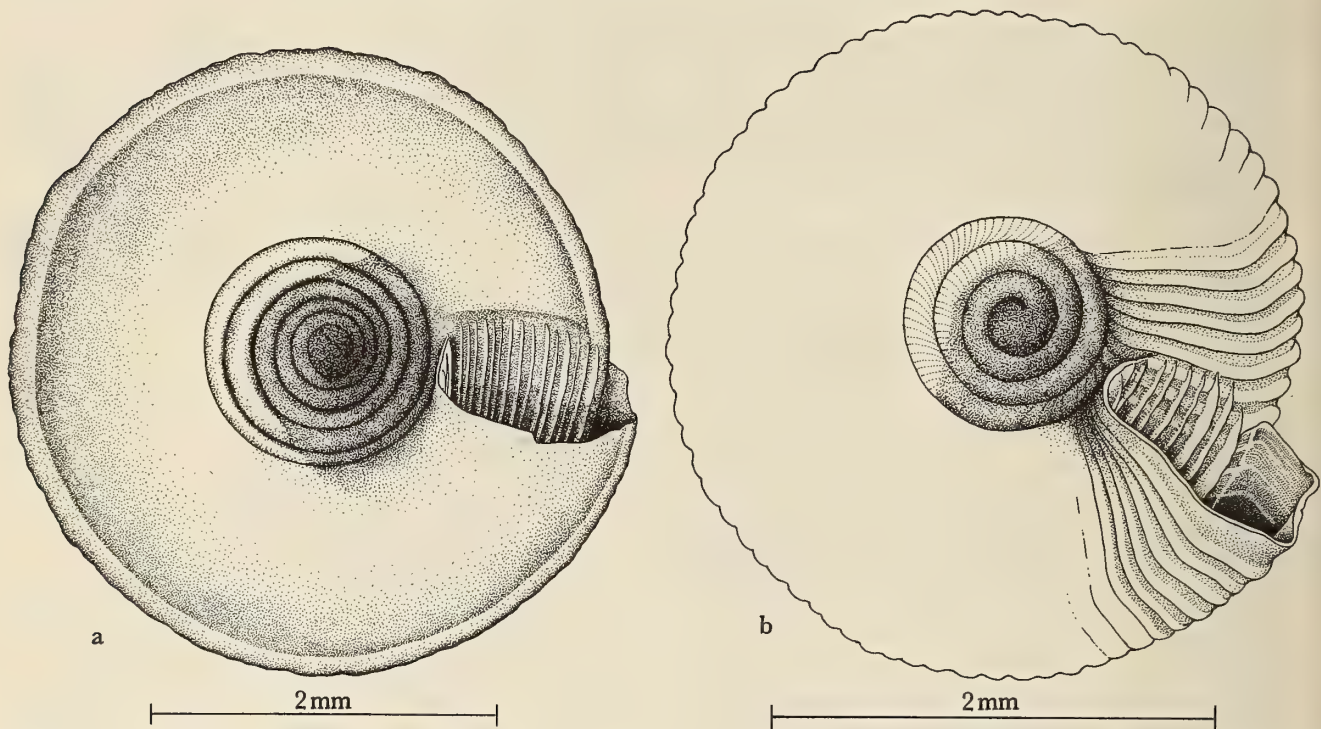


Figure 17

Priceconcha tuvuthaensis Solem, new species.

a. Holotype. FMNH 168131. Bottom view of shell.

Thaumatonodon spirrhymatum Solem, new species

b. Holotype. FMNH 176001. Bottom view.

Explanation of Figures 1 to 4

Thaumatonodon spirrhymatum Solem, spec. nov.

Figure 1: Paratype, FMNH 168221. Apical shell sculpture on second whorl showing alternation of major and micro-radials, plus the "squiggly" micro-spirals. X 1 150

Priceconcha tuvuthaensis Solem, gen. nov., spec. nov.

Figures 2-4: Fragments of dissected paratype, FMNH 168136.

Figure 2: single bead on palatal barrier viewed from a right, very slightly posterior angle. X 535

Figure 3: detail of palatal bead surface viewed from directly above. X 2 100

Figure 4: a 45° angled view of individual denticles on another palatal bead. X 5 850



lower. Whorls strongly rounded out to supraparipheral sulcus, followed by protruded, narrow, thread-like keel, lower palatal margin almost flat, columellar margin strongly rounded. Aperture ovate, very strongly flattened laterally below periphery, inclined about 35° from shell axis. Parietal lamellae 4, extending posteriorly for more than 1 full whorl, with 10 or 11 accessory traces: all major parietals very low, lamellar blades, with very gradual anterior descension; separable from traces by the presence of low beads (Figure 1) that are visible $\frac{2}{3}$ of a whorl inside aperture; 4th parietal without beads and recognizable only by being slightly wider than adjacent traces. Accessory traces as long as major lamellae, 1 to 3 between each pair, variable in exact position, with or without a superior lamellar trace, two usually below 4th parietal. Columellar lamellae 2, lying parallel to the plane of coiling, extending posteriorly a full whorl, with gradual anterior descension across callus almost to lip edge. Accessory traces between 1st and 2nd and then below 2nd columellar, traces less than half height of major lamellae, terminating distinctly posterior of major lamellar ending. Palatal lamellae 5, extending posteriorly more than one whorl, with 3 or 4 accessory traces; first 4 palatals subperipheral, progressively increasing in height, with gradual anterior descension, beading deeply recessed and inconspicuous, widely spaced; 5th palatal supraparipheral, located just above keel, a low lamellar ridge without beading on visible portion. Accessory traces located below 1st palatal, between 2nd and 3rd, and one or two located above 5th palatal.

The relatively large size, increased whorl count, very long and numerous apertural barriers, widely open umbilicus, reduced sculpture, and prominent keel easily separate *Priceconcha tuvuthaensis* from any species of *Thaumatodon* or the other genera sharing its anatomical peculiarities. Of the generalized endodontid genera, only the larger species of *Nesodiscus* are similar in shape and sculpture reduction. They differ immediately in anatomical features, their very much larger size, and gross reduction in number and prominence of apertural barriers.

Description: Shell larger than average, with slightly more than $7\frac{1}{2}$ tightly coiled whorls. Apex and spire strongly elevated, slightly rounded above, H/D ratio 0.528. Sculpture as in diagnosis. Umbilicus broadly "V"-shaped, regularly decoiling, contained 2.73 times in the diameter. Whorl contour and apertural contours as in diagnosis, except for presence of eleven parietal traces and four palatal traces. Color reddish-yellow horn, without traces of flammulations. Height of holotype 2.14 mm, diameter 4.05 mm.

Holotype: Fiji: Lau Archipelago, Tuvutha Island, west coast in heavy forest on limestone at 100 feet elevation.

Collected on trunks of trees during wet spell by Laurie Price on October 2, 1970. Field Museum of Natural History number 168131.

Paratypes: FMNH 168136, 2 specimens.

Description of soft parts: Foot and tail retracted in all examples, so length not measured. Body color yellow-white, no darker markings.

Posterior portion of pallial roof (Figure 19 b) with very narrow 2.4 mm long kidney (K), rectal arm reduced in prominence. Heart (H) elongated and very slender, paralleling hindgut. Pulmonary vein (HV) simple and unbranched. Ureter (KD) reflexion partly above fold in kidney, extending to ureteric pore (KX) just anterior of rectal kidney margin and next to hindgut (HG). Posterior margin of kidney deeply indented by intestinal loop (I). Total length of pallial cavity about three-quarters of a whorl. Surface of anterior pallial roof heavily infested with encysted parasites, probably a nematode, as shown in Figure 19 a.

Ovotestis (Figure 19 a, G) situated well above stomach (IZ) apex, consisting of tightly clustered, palmately clavate alveoli opening into a single collecting tubule which continues on columellar side of intestine (I) as hermaphroditic duct (GD). Latter without kinking (Figure 20 a), entering laterally near base of very elongated carrefour (X). Talon (GT) very long and tapering, entering head of carrefour, both partly buried in albumen gland (GG), which, together with the head of the spermatheca (S), lies just apical of pallial cavity apex. Prostate (DG) and uterus (UT) proportionately short, completely separate tubes only lightly bound together by connective tissue. Free oviduct (UV) section of female tract more expanded than uterine, but state of preservation and heavy parasitization prevented any detailed examination of structural differences. Atrium (Y) short, slightly wider in diameter than free oviduct.

Vas deferens (VD) very long, highly convoluted in part (possibly an artifact of contraction), entering epiphallus (E) through a valve. Epiphallus about two-thirds length of penis, quite thick, internally (Figure 20, b) with two high, rather complex pilasters (PP) that continue through penis to atrium, but decrease rapidly in height. Penis (P) about 1.5 mm long, with spermathecal shaft (S) inserting near base. Penial retractor muscle (PR) arising on diaphragm, inserting on junction of epiphallic and penial portion of the terminal duct. Head of spermatheca very slender and elongated.

Radular teeth typical Endodontidae. Central (Figure 5) tricuspid, slightly larger than 1st laterals. Early laterals (Figure 6) bicuspid, simple, ectocone more than half

length of mesocone. Upper anterior margin of early laterals with prominent knob behind mesocone. Anterior tooth margin sloping backwards and downwards at about 45° angle to basal plate attachment on radular membrane, slope length about half total tooth length. Posterior basal plate margin with prominent bump in front of ectocone (Figure 6, upper left) and mesoconal area to receive anterior upper margin of next tooth under stress conditions. Mesoconal supporting ridge large, evenly curved from cusp tip to mid point of tooth height, then curving backwards to join basal plate. Subsequent lateral teeth (Figure 7) developing fine denticulations on the outside edge of the ectocone. During lateromarginal transition (Figure 8) these denticulations appear also on the outside edge of mesocone. Transition to marginal teeth also marked by distinct development of a narrow, sharp endocone (Figures 8, 9), frequently with considerable ectoconal splitting. Transition between laterals and marginals occurring over a 3 to 5 tooth area.

Digestive and free muscle systems without unusual features. Entire body heavily invaded by encysted parasites, which are ovate in shape, averaging about 0.2 mm in maximum length. Based on dissection of an adult specimen 4.54 mm in diameter, from FMNH 168136.

Remarks: Two living specimens, an adult and a juvenile, were collected on tree trunks in very damp forest up to 10 feet above ground level. Ascension of a tree trunk is not unprecedented in the family, although highly unusual. A few Hawaiian endodontids and one species of *Libera* from a very wet area on Tahiti have been taken in such arboreal situations, but most of the 180 species level taxa are strictly terrestrial. Quite possibly the remarkable degree of shell sculpture reduction in *Priceconcha* correlates with this habitat. Virtually no endodontids as small as *Priceconcha* show any significant degree of sculpture reduction (SOLEM, in press). Elsewhere (SOLEM, in press) I hypothesize concerning the significance of shell sculpture to a litter dwelling snail. If *Priceconcha* has indeed become an essentially arboreal or semiarboreal species, then the vir-

tual loss of the sculpture in a moss habitat becomes less surprising.

The beading on the apertural barriers (Figures 2–4) is typical in character, although narrower than in most *Thaumatodon* (see SOLEM, 1973, Figures 11–13). Elevated denticles on the beads (Figure 2) are restricted to the posterior raised portion of each bead and are absent from the rest of the barrier edge. Viewed at higher magnifications (Figures 3, 4), the individual denticles are seen as additive elements to the surface. In all cases the points of the denticles are directed towards the outside of the aperture. In the group of genera including *Thaumatodon*, *Priceconcha*, the Palau genus and other new Lau Archipelago genus, such denticles are restricted to the bead surfaces, whereas in other Endodontidae they are found along the upper edge of the major barriers on at least the posterior third to half.

Features of the pallial region and genitalia that differ obviously from those of *Thaumatodon spirrhydatum* should not be assigned major phyletic significance. Essentially all of them are correlatives of the change in whorl width, coiling pattern and thus visceral elongation resulting from the increased whorl count of *Priceconcha*. Narrowing of the kidney and reduced rectal kidney arm prominence (compare Figures 19 b and 21 c), plus the much more tightly coiled intestinal loop relate to the narrow cross-sectional area of the whorl. The longer talon and carrefour in *Priceconcha* (Figure 20 a) compared with *Thaumatodon* (Figure 19 b), and the very striking difference in relative “free oviduct-uterus” length shown in the same figures are other demonstrations of this change. Elongation of the genitalia in *Priceconcha* was not uniform, but took place primarily in the region between the end of the prostate and the atrium.

Such patterns of “zonal shifts” are characteristically found in snails with increased whorl counts. They also occur as compacted zones on slugs or semi-slugs, where the visceral hump has been shortened in the course of slug evolution. In neither situation is there any pattern as to which zone of the pallial and terminal genitalia is involved

Explanation of Figures 5 to 9

Priceconcha turuthaensis Solem, gen. nov., spec. nov.

Figures 5–9: Radular elements from dissected paratype, FMNH 168136.

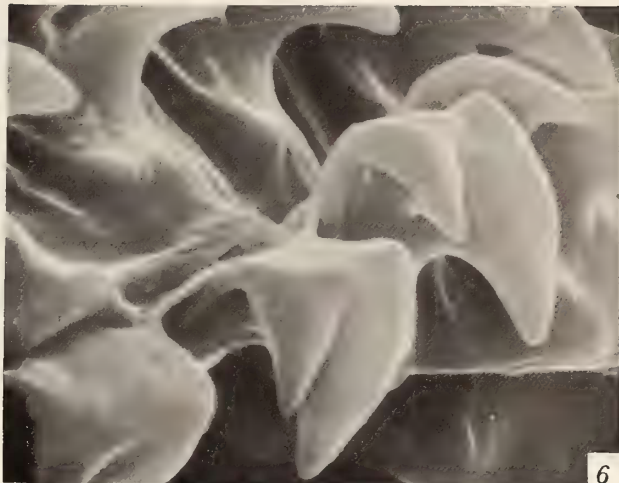
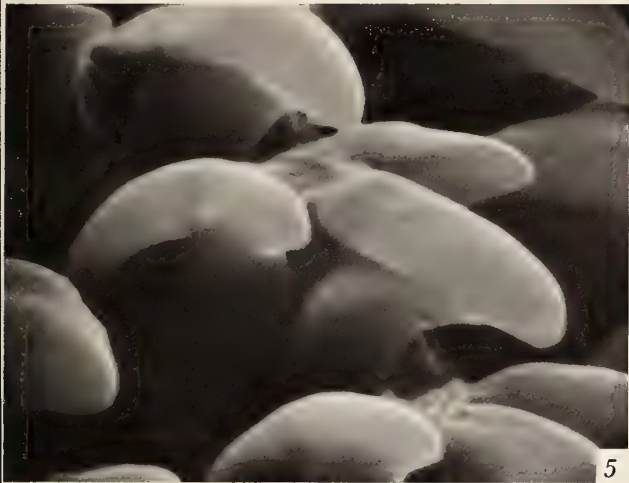
Figure 5: central tooth seen from a low posterior angle. X 9 500

Figure 6: early lateral teeth on a fold in the radular membrane showing the point of attachment and anterior part of the tooth that is free from the basal membrane. X 5 425

Figure 7: late lateral teeth viewed from a low, outside angle showing serrations on ectoconal and mesoconal cusp edges. X 9 800

Figure 8: lateromarginal transition area on left side of radula viewed from a low outside angle. X 4 775

Figure 9: marginal teeth from right side of radula seen from almost directly above, showing variations in ectoconal splitting. X 8 700



in the zonal shift. It can be any part. Since no *Thaumatodon* are known to occur on Tuvutha, the lack of alterations in penial structure from the basic *Thaumatodon* pattern has no significance.

In summary, *Priceconcha tuvuthaensis* is a genus and species characterized by major conchological changes, but only comparatively minor anatomical changes. It also seems to differ in habitat from the vast majority of endodontids.

Thaumatodon Pilsbry, 1893

Manual of Conchology, 2nd series, 9:26

Endodontidae with typical apical and microsculpture, major sculpture enlarged in many species, frequently greatly reduced on body whorl. Apertural barriers with small serrated beads on upper margin, usually several accessory lamellar traces developed. Anatomically characterized primarily by differentiation of an epiphallic zone in the penis and spermatheca inserting on penial side of the peni-oviducal angle.

Type Species: *Pitya multilamellata* Garrett, 1872 by OD.

Including the new species described below, there are nine species that belong to *Thaumatodon* as restricted by SOLEM (in press). *Thaumatodon multilamellata* (Garrett, 1872) from the Cook Islands, *T. hystricelloides* (Mousson, 1865) from Samoa, *T. decemplicata* (Mousson, 1873) from the Ellice Islands, two undescribed species from Tonga, and four species from the Lau Archipelago of Fiji—*T. subdaedalea* (Mousson, 1870), undescribed species from Wangava and Mango, and the species from Thithia described below as *Thaumatodon spirrhymatum*. In addition, the new genus *Priceconcha* and a second undescribed genus from the Lau Archipelago are derivatives of *Thaumatodon*, making this area a major center of diversity. It is highly probable that additional undescribed species exist in Lau. The only other closely related genus is an undescribed taxon from the Palau Islands, which, together with *Thaumatodon*, *Priceconcha* and the other new genus from Lau, form an anatomically well differentiated, monophyletic section of the family.

Thaumatodon spirrhymatum Solem, spec. nov.

(Figures 1, 10 to 15 and Figures 17b, 18, and 21)

Diagnosis: Shell large for genus, diameter 2.96 mm–3.45 mm (mean 3.23 mm), with $4\frac{1}{2}$ to $5\frac{3}{8}$ normally coiled whorls. Apex and early spire flat or barely protruding,

whorls of lower spire descending much more abruptly, attachment of upper palatal edge along lower margin of peripheral keel after development of latter, H/D ratio 0.441–0.564 (mean 0.494). Umbilicus broadly "V"-shaped, regularly decoiling, contained 3.17–3.92 times (mean 3.53) in the diameter, margin of last whorl very sharply rounded, but not keeled. Apical whorls not differentiated in form or sculpture from postnuclear whorls, sculpture

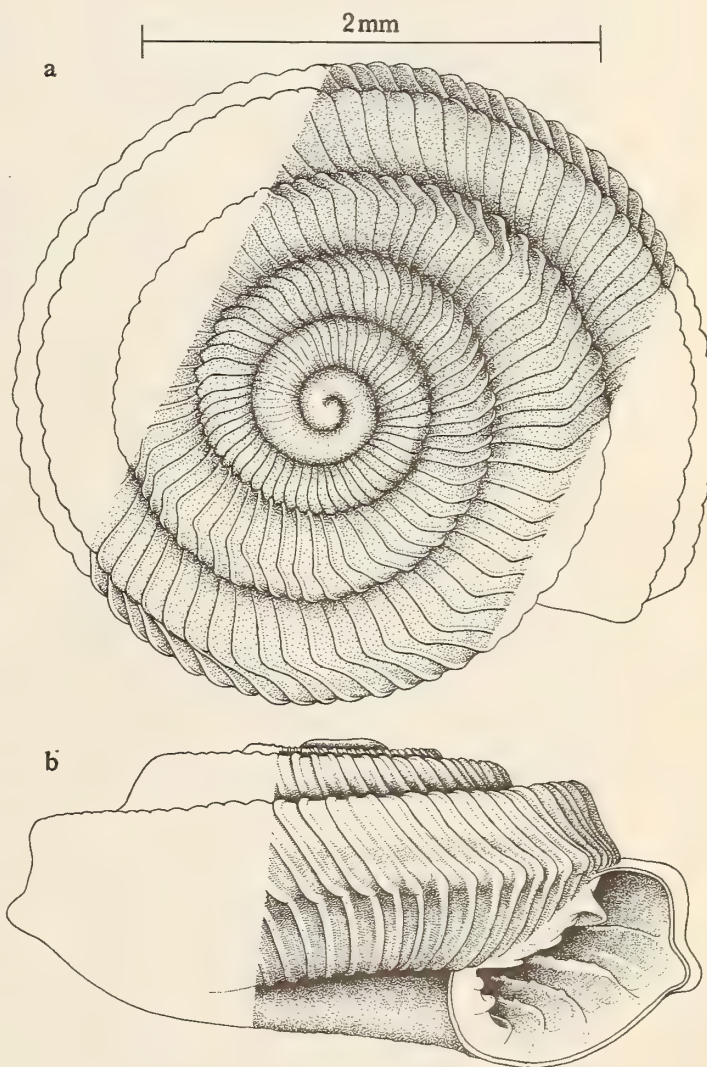


Figure 18

Thaumatodon spirrhymatum Solem, new species.

Holotype. FMNH 176001: *a*, top view of shell; *b*, side view of shell with parietal lamellar traces omitted. Scale line equals 2 mm

(Figure 1) consisting of alternating major ribs and micro-radial ribs, crossed by a microspiral sculpture of typically "squiggly" spiral riblets. On postnuclear whorls, sculpture of high, broad, rounded, slightly protractively sinuated, normally crowded radial ribs, 66–120 (mean 81.3) on the body whorl, whose interstices are one to three times their width. Major ribs become slightly nodose on crossing keels, ribbing often greatly reduced on last eighth to quarter of body whorl. Microsculpture very fine, often eroded from major rib surfaces, a combination of three to eight radial riblets crossed by slightly finer and more crowded spiral riblets. No secondary spiral sculpture. Sutures on early spire deep, on lower spire and body whorl flatly rounded out to a slightly protruding and strongly rounded supraparipheral keel, then concavely rounded to thread-like and strongly protruded peripheral keel, lower palatal wall rather flatly rounded down to sharply rounded columellar margin. Aperture basically ovate, distorted in outline by keels, inclined about 15° from shell axis. Parietal lamellae 4, extending posteriorly beyond line of vision, with four or five accessory traces: upper a very high, thin blade, with four low, narrow beads at widely spaced intervals on posteriorly visible two-thirds of lamella and sharp anterior descension; 2nd much lower, with very gradual descension over anterior third, posterior beading more prominent, spaced at same intervals; 3rd lower than 2nd, only three posterior beads visible, very gradual anterior descension; 4th greatly reduced in height, only remnants of beading visible, actually lower than largest trace. Accessory traces between 1st and 2nd, 2nd and 3rd, 3rd and 4th, and below 4th parietal, progressively decreasing in size from top to bottom, with upper trace higher than 4th parietal. A 5th very low and thread-like trace may be located above the upper parietal. Anterior margins of all major lamellae and lamellar traces nearly even. Columellar lamellae 2, lying parallel to plane of coiling, both raised lamellar ridges, upper slightly lower, both crossing peak of columellar callus, but degree of relative anterior extension variable. Palatal lamellae 4, extending posteriorly three-

sixteenths of a whorl, with 3 or 4 accessory traces: lower 3 palatals subperipheral, with three moderately prominent beads above on each (Figures 10–12), lamellae becoming progressively higher with more gradual and longer anterior descension, extending almost to lip edge; 4th palatal just above peripheral keel, a lamellar ridge slightly lower than 3rd palatal, weakly beaded above, with sharp anterior descension. Traces located at columellar-palatal margin, usually a very weak trace between 1st and 2nd, more prominent traces between 2nd and 3rd, 3rd and 4th palatals.

Thaumatodon spirrhymatum is immediately recognizable by its bi-keeled body whorl, relatively flat spire and characteristic sculpture. Other Lau Archipelago species such as *T. subdaedalea* (Mousson, 1870), are similar in shape, umbilical width and general appearance, but have rounded body whorls and much different sculpture. Tongan species and the Samoan *T. hystricelloides* (Mousson, 1865) have far narrower umbilici, a much more elevated spire, rounded whorls, wider sculpture that is far more reduced on the body whorl, and much more massive apertural denticles. The Ellice Island *T. decemplicata* (Mousson, 1873) is much smaller in size, has only one columellar tooth, and a rounded periphery.

Description: Shell large, with 4½ normally coiled whorls. Apex and early spire slightly protruding, lower whorls descending more rapidly, H/D ratio 0.484. Apical whorls with sculpture partly eroded, sculpture on lower whorls as in diagnosis, body whorl with about 73 rather widely spaced major radial ribs becoming very reduced on last eighth whorl of gerontic growth. Umbilicus broadly "V"-shaped, regularly decoiling, contained 3.17 times in the diameter. Sutures deep on early whorls, shallow when whorl attachment reaches keel base. Supraparipheral keel slightly protruding, rounded, peripheral keel strongly protruding, thread-like. Color yellow-white, with regularly spaced reddish flammulations. Aperture and lamellae as in diagnosis, with trace between 1st and 2nd palatals barely visible. Height of holotype 1.51 mm, diameter 3.13 mm.

Explanation of Figures 10 to 15

Thaumatodon spirrhymatum Solem, spec. nov.

Figures 10–15: Shell fragments and radula from a dissected paratype, FMNH 168221.

Figure 10: anterior portion of lower palatal lamellar barrier (with nodose beads above) and accessory lamellar traces (no beads above)
X 92

Figure 11: lateral view of a single lamellar bead on a palatal lamellar barrier.
X 1 850

Figure 12: details of denticles on a bead.
X 9 425

Figure 13: central (tricuspid) and first lateral radular teeth, strands are partly macerated muscle tissue that did not come loose in the sonic cleaner.
X 4 750

Figure 14: lateral teeth from left side of radula near posterior end.
X 4 825

Figure 15: marginal teeth from right side of radula near posterior end.
X 5 425